Proposed Answer to KC 1117 – (updated 13-June-2013)

The formulas in CSR-BC apply the most commonly used notation of the incomplete Gamma functions, e.g. as used by:

[1] Abramowitz, M., Stegun, I. (eds.), Handbook of Mathematical Functions: with Formulas, Graphs, and Mathematical Tables. Chapter 6.5. Dover Publications Inc., New York (1965)

These incomplete gamma functions are the “non-normalized” incomplete gamma functions.

The definitions and relationships of these incomplete gamma functions are provided below (reference is made to Reference [1]).

The Common Structural Rules for Bulk Carrier, Ch. 8, Sec. 2 [3.3.1] uses the following formula to calculate the element fatigue damage:

$$D_j = \frac{\alpha_j N_L}{K} \frac{\Delta\sigma_{E,j}{}^4}{(\ln N_R)^{4/\xi}} \left[\Gamma\left(\frac{4}{\xi}+1, \nu\right) + \nu^{-3/\xi} \gamma\left(\frac{7}{\xi}+1, \nu\right) \right]$$

Where:

$$\nu = \left(\frac{100.3}{\Delta\sigma_{E,j}}\right)^{\xi} \ln N_R$$

Γ : Type 2 incomplete gamma function

γ : Type 1 incomplete gamma function

Γ, a Type 2 incomplete gamma function, corresponds to the following function:

$\Gamma(a,x)$: Upper Incomplete Gamma function

$$\Gamma(a,x) = \int_x^{\infty} t^{a-1} \cdot e^{-t}\, dt \qquad [1]$$

γ, a Type 1 incomplete gamma function, corresponds to the following function:

$\gamma(a,x)$: Lower Incomplete Gamma function

$$\gamma(a,x) = \int_0^{x} t^{a-1} \cdot e^{-t}\, dt \qquad [1]$$

The $\Gamma(a,x)$ function and $\gamma(a,x)$ function follow the relationship:

$$\gamma(a,x) + \Gamma(a,x) = \Gamma(a)$$

Where:

$\Gamma(a)$: Complete Gamma function

$$\Gamma(a) = \int_0^{\infty} t^{a-1} \cdot e^{-t}\, dt \qquad [1]$$